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Conceptual Model of Competitiveness and Comparative Advantage in Agricultural Trade

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ABSTRACT

Many economists believe that the United States is losing its competitive edge in world agricultural trade. Some believe that this short-term loss in competitiveness will affect the Nation's ability to be a major producer and exporter in the longer term. This report develops a simple general equilibrium model in which changes in competitiveness can be evaluated with respect to their longer term consequences for U.S. agricultural production and trade. The model extends the basic Ricardo-Viner trade model into a dynamic specification that recognizes the importance of international capital flows and monetary policy. All traded goods are treated as middle products that must be processed by domestic factors of production before final consumption. The role of input markets within all countries is stressed. Investment activities provide a role for private firms and for government policy in directing medium-term changes in the competitive position of particular sectors.

Keywords: Agricultural trade, macroeconomics, economic model

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INTRODUCTION

Competitiveness is the ability and willingness of a firm to secure at the expense of one or more other firms the business of a customer by the offer of the most favorable terms. In the face of enormous trade imbalances, politicians have expanded the concept of competitiveness to apply to nations as well as firms. Comparative advantage explains observed trade patterns among nations. It uses resource endowments, investment patterns, implemented technologies, preference structures, income levels, and the like to explain trade. It is usually nation-specific rather than firm-specific as the concept of competitiveness is. At any particular time, comparative advantage determines the set of countries that compete against each other in the sale of specific commodities. Comparative advantage is the underpinning of competitiveness. It deals with longer term tendencies to prevail against short-term competitive pressures.

Knowledge of the relative strength of export competitors derived from the study of comparative advantage is important in the design of policy. In its dynamic form, comparative advantage offers likely trade outcomes for the medium to long term. It places realistic estimates on the likelihood of success of policies designed to improve the welfare of commodity producers and the consuming public.

The goal of this paper is to establish a framework for analyzing the link between competitiveness and comparative advantage. It extends or combines certain well-known neoclassical approaches to trade and macroeconomic theory in a dynamic specification. Two points of emphasis include the role of adjustment costs in factor reallocation and the size of a country's external debt. Although the model will not exhaust the full range of competitiveness issues, it is an attempt to provide the framework for measuring the effect of the debt crisis, dollar appreciation, and factor immobility on the agricultural sector. Another implicit goal is to identify a research agenda for branches within the Economic Research Service (ERS) that concern themselves with international macroeconomics and trade policy. The modeling exercise provides a framework about which to think about the factors underlying agricultural comparative advantage and long-term competitiveness.

BACKGROUND

The 1970's saw a large expansion in U.S. agricultural trade. This expansion began in 1973 when the value of U.S. agricultural exports increased 81.8 percent from the previous year. This was the first year of a trend in which the value of agricultural exports would grow to a peak of $44 billion in 1981.

Also in 1973, the U.S. dollar was formally dissociated from any relationship with the value of gold and was allowed to float in value. Its value in terms of other currencies was determined by the forces of supply and demand.

Many economists believe that these events were not independent. They claimed the dollar, before floating, was overvalued in terms of other currencies (22). 1/ The overvaluation was a tax on U.S. agricultural products because they appeared expensive to potential trading partners. When the dollar was allowed to float, it depreciated in value. U.S. agricultural exports became competitive in world markets and remained so throughout the 1970's.

Two other events figured prominently in the 1970's, both resulting from the oil supply shock of 1973. First, the fourfold increase in oil prices resulted in expanded liquidity in the form of petrodollar deposits. Second, developed countries pursued an accommodative monetary policy in response to the oil price increase. Along with the shift to a floating exchange rate system, which decreased the demand for foreign exchange reserves, these events propelled world liquidity to unprecedented levels. The liquidity was recycled mainly to middle-income oil-importing countries where real rates of return on investment contrasted favorably with real negative rates of return in developed countries (23). In turn, these middle-income countries increased imports of all types of products, including U.S. agricultural products. The share of total U.S. agricultural commercial sales to all developing countries grew from 30 percent in 1975 to 35 percent in 1980. Most of these sales were concentrated in the middle-income countries.

Events of the 1980's have contrasted sharply with those of the previous decade. The roots lie in the monetary response to the second oil supply shock in 1979. Instead of following an accommodative policy as in 1973, central banks of the major developed countries followed a tight money policy that increased their interest rates and decreased the rate of inflation. One of the byproducts of this action was a world recession and a sharp drop in the prices of internationally traded primary products. Heavily indebted middle-income countries were faced with lower prices for their export products and higher debt service payments resulting from higher interest rates. Meanwhile, gigantic U.S. Federal deficits and a perceived lack of investment opportunities worldwide contributed to large capital inflows into the United States. These factors contributed to a rapid, sustained appreciation in the value of the U.S. dollar. From the third quarter of 1980 to the first quarter of 1985, the value of the dollar, as calculated by the International Monetary Fund, rose by more than 60 percent. Even compared with the average value for the period 1974-83, the dollar appreciated by 43 percent.

Changes in competitiveness have been measured by changes in the value of agricultural exports and market share. During the 1980's, U.S. agricultural exports generally have become less competitive in world markets. The value of total agricultural exports fell from $43.8 billion in 1981 to $31.2 billion in 1985. The U.S. share of the world market for grains fell from 54 percent to 39 percent over the same period. Even with the depreciation of the dollar since 1985, U.S. agricultural exports have not picked up significantly.

The downturn can be attributed to a number of factors. Heavily indebted middle-income countries, which were good customers during more prosperous

1/ Underscored numbers in parentheses refer to references at the end of this report.

times, now need to generate surpluses on their trade accounts to meet debt service commitments. Foreign income growth, upon which import demand depends, has suffered as a result. The high value of the dollar a couple of years ago and the downward inflexibility of U.S. grain prices due to the U.S. loan rate have made U.S. grain exports more expensive in a declining market. Haley and Krissoff, for example, found that during the flexible exchange rate period, a 1-percent change in the real value of the dollar (as weighted against export competitors) resulted on average in an opposite change in the volume of wheat and feed grain exports of 2.4 and 1.4 percent, respectively (12).

To date, there have been no efforts to link the decline in agricultural competitiveness to changes in agricultural comparative advantage. In theory, comparative advantage should be relevant because it attempts to account for trade flows as a function of differences in country-specific factors. Development of the theory begins with the correlation of the pattern of trade and commodity price differentials that exist before trade. That is, countries tend to export goods for which pre-trade prices are lower than those of potential trading partners. Conversely, countries tend to import goods for which pre-trade prices are higher than those of potential trading partners. Pre-trade price differentials are a function of differing factor endowments (including natural resources), technology, income, and/or preferences. Policy-induced price distortions, however, are typically excluded as a factor.

A strength of the comparative advantage approach is that it accounts for trade in the context of general equilibrium. Feedback effects from input and competing output markets are incorporated into the analysis. The direct effects evaluated from partial analysis may be either strengthened or moderated as a result. A perceived disadvantage to the approach is that it is static in nature. Adjustments within an economy in moving to a new equilibrium are not stressed, although some economists, such as Neary (16), have recognized this aspect. Other attempts to make the theory dynamic tend to emphasize results that would hold in a steady state (9, 26).

One of the distinguishing characteristics of agriculture is the contribution of immobile factors to production. Investment in the natural resource base is a necessary element in defining a nation's ability to produce and compete in world markets. The capital used in agricultural production usually has zero opportunity cost outside the sector. This observation implies that comparative advantage is a reflection of past capital investments as well as natural resources.

In an uncertain world, the future of the agricultural sector is tied closely to current events through the allocation of available savings to various investment opportunities in an economy. Without investments in specific forms of capital, it is possible for a country to lose its comparative advantage. A relevant concern for policymakers is the implication of the present loss of competitiveness to the future of the agricultural sector.

The rest of this paper examines a conceptual model relevant for assessing agricultural comparative advantage in the context of macroeconomic disturbances. The model emphasizes the role of adjustment costs in factor markets and the size of a country's external debt. Although the model does not deal specifically with government policies that may distort commodity markets, the model is flexible enough to include rent-seeking behavior by representatives of input factor groupings.

AGRICULTURAL COMPARATIVE ADVANTAGE

There are two views of comparative advantage: the Ricardian and Heckscher-Ohlin. The Ricardian view stresses that a country exports commodities that have higher factor productivity and imports commodities that have lower factor productivity than those of a trading partner. The reason for trade is based on differing production techniques in differing nations. The Heckscher-Ohlin view, on the other hand, stresses differences in the initial endowment of factors used in production rather than differing techniques. A nation exports goods that make the heaviest use of abundant factors of production, and it imports goods that require the heaviest use of scarce resources. In both approaches, consumers in all countries are assumed to maximize identical homothetic utility functions. Demand for any particular commodity is a function of relative prices alone. Income differentials between countries do not influence the pattern of trade.

Establishing the comparative advantage framework for agriculture even in static terms is not straightforward. There is little agreement among economists as to the applicability of either Heckscher-Ohlin or Ricardian versions of comparative advantage to agriculture. Intercountry differences in technology (reflecting Ricardian theory) and in natural resources (reflecting Heckscher-Ohlin) both have been cited as important determinants of agricultural trade flows (1). In addition, because the income elasticity of demand for agricultural products tends to decline as income increases, intercountry income differentials can be important as well (14).

Building on the framework of Mundlak and Cavallo (4), Haley and Abbott (11) have synthesized the Ricardian and Heckscher-Ohlin approaches into a theory of comparative advantage based on economic growth. It is essentially a dynamic version of the basic Ricardo-Viner type of trade model, adjusted to take account of technical change in the agricultural sector. More explicitly, their model is one of a small, representative country that is not necessarily in longrun equilibrium. There are two final goods: an agricultural good and a manufacturing good. The model accounts for economic growth as a function of changing resource allocations that are affected by imperfect factor mobility and technological change. Initial output prices and domestic savings behavior determine domestic production, consumption, and investment. Because output prices are assumed to be set in the world market, trade equilibrates supply and demand in both sectors. Stockholding, although important in the short term, is assumed to be of no importance. Over time, changes in factor allocations are guided by differentials in factor returns between sectors and by technological change. These changes in turn cause changes in future production, demand, and trade. The model stresses the importance of initial conditions in directing the course of economic growth.

Although the model captures many dynamic features of changing comparative advantage, it should be revised to make it both more realistic and more relevant for competitiveness issues. First, it needs explicit representation of a monetary sector. Its omission from the model implies the shortrun neutrality of money. This omission means that changes in nominal prices are exactly offset by changes in the rate of inflation, leaving the real values of economic variables unchanged. Because it is assumed that economic agents respond only to these real changes, changes in money supply have no effect on trade flows and, by implication, competitiveness. This result runs counter to that of Rausser and others (19) who found that money supply changes, at least in the short run, can affect the real level of agricultural prices.

The remainder of the financial side of their model is weak as well. The only capital inflows explicitly recognized are foreign aid transfers. With increased integration of international financial capital markets, this specification is very unrealistic. Trade in bonds and equity should be incorporated to reflect that savings can migrate across borders to seek the highest return. Also, this specification is necessary to recognize the effect of the debt crisis on the international trading system.

An important empirical consideration is that most trade does not take place in the form of final goods, but rather in middle products. This consideration implies that a traded good requires further processing before it reaches the final consumer. This is certainly relevant to agricultural goods. Of the $344 billion spent by U.S. consumers on food in 1985, $86 billion, or 25 percent, represented the farm value of the food purchased and $117 billion, or 34 percent, went to pay workers' wages in the food marketing system (27). The remaining 41 percent went to pay other marketing expenses. While other marketing expenses have stayed in the range of 37-41 percent since 1975, the farm share value of food expenditure has decreased from 33 percent and the wage share increased from 29 percent.

Focusing on trade in middle products yields more realism and flexibility in modeling. Unlike the Haley-Abbott model, final consumer demand influences the price of food and other products. Although the law of one price adjusted for transport costs may hold at the border for internationally traded goods for a set of countries, the price of final goods may differ across nations according to the value added by domestic resources.

THEORETICAL MODEL

The purpose of modeling in this study is to facilitate an understanding of changing comparative advantage. The model is developed in the form of an investment planning function as suggested by Abbott and Thompson (1). In neoclassical tradition, the objective is the maximization of the discounted value of consumption over time, subject to a number of constraints.

The results will essentially be the same as those derived in a competitive setting in which consumers maximize utility and producers maximize profits. The interpretation of the similarities is that social objectives can be obtained by the efficient working of the market economy. One purpose of the model is to show where bottlenecks could develop. These arise from rigidities in labor and capital stock adjustments and from initial conditions of heavy indebtedness.

Structure of the Real Economy

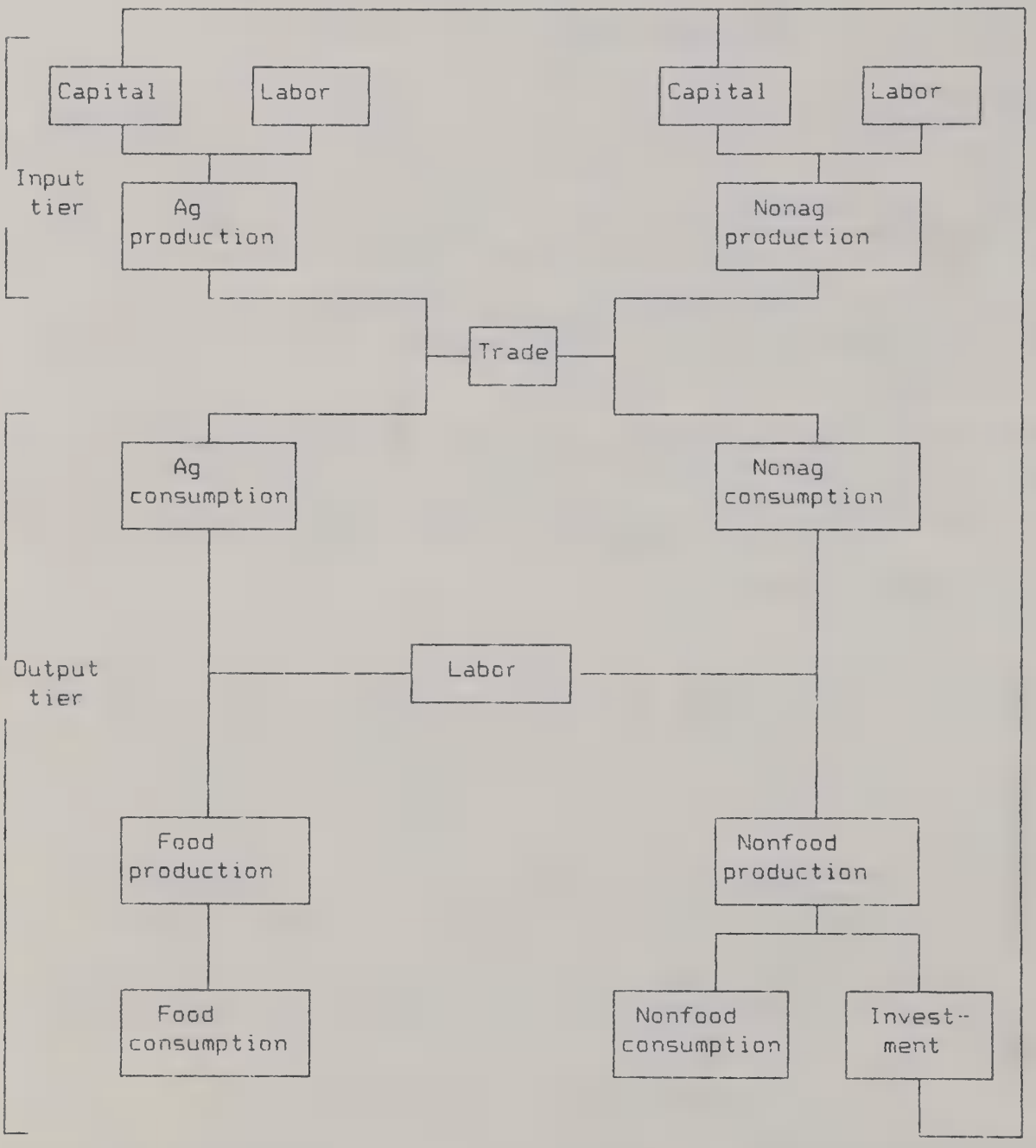
Because international trade is assumed to take place in middle products, local economic activity can be separated into two tiers. 2/ The Input Tier combines local resources to produce middle products for the world market. The Output Tier uses tradeable middle products as inputs to be combined with local resources to produce final goods for consumption. (fig. 1).

A number of tiers can be modeled, depending on the issues in question. The multitiered approach is especially relevant for evaluating trade in high-valued products. The assumption of the nontradeability of final consumer

2/ The trade aspect of the model is due principally to Sanyal and Jones (21).

Figure 1.

The Real Economy at Time t



goods reflects that all goods within a particular nation contain the input of some domestic factors of production. At the very least, this input includes such marketing costs as transportation charges and sales expenses. In this paper, the model is developed in a simple two final goods, two intermediate goods format to focus on the dynamics.

Input Tier

Production in the input tier consists of an agricultural good (X_a) and a nonagricultural good(X_b). Each good is produced by a combination of sector-specific labor (L_a and L_b, respectively) and sector-specific capital (V_a and V_b, respectively). As explained below, neither factor is instantaneously mobile. The production of each good is described by the following linearly homogeneous production functions:

$$X_a(t) = X_a[L_a(t),V_a(t)] \quad (1)$$

$$X_b(t) = X_b[L_b(t),V_b(t)] \quad (2)$$

Improved land is treated as a portion of sector-specific capital in agricultural production. 3/ At time t, the supply of labor and capital in both input tier sectors is assumed to be fixed and fully employed:

$$L_a^*(t) - L_a(t) = 0 \quad (3)$$

$$L_b^*(t) - L_b(t) = 0 \quad (4)$$

$$V_a^*(t) - V_a(t) = 0 \quad (5)$$

$$V_b^*(t) - V_b(t) = 0 \quad (6)$$

where * signifies fixed supply. This specification of production is essentially the Ricardo-Viner model, which has been used in standard trade theory (7).

Output Tier

Description of the output tier preserves the two-good, two-factor format of the input tier. There are two produced goods: food (X_1) and nonfood (X_2). The goods produced in the input tier serve as commodity-specific inputs that are combined with labor according to the following linearly homogeneous process:

$$X_1(t) = X_1[C_a(t),L_1(t)] \quad (7)$$

3/ This specification of improved land as a portion of sector-specific capital rather than as a third factor of production is based on results from the empirical specification of the Haley-Abbott model. The Haley-Abbott result was based on analysis that aggregated production across the entire range of agricultural products. Although the result is likely to apply to individual crops, the degree to which investment in land contributes to individual crop production likely varies from crop to crop. The capital necessary to adopt or implement new technologies depends on specific crop characteristics and agroecological and infrastructural conditions within a particular country. This is an important issue when examining the competitiveness of trade in individual commodities.

$$X_2(t) = X_2[C_b(t), L_2(t)] \quad (8)$$

where L_1 and L_2 are labor employed in sectors 1 and 2, respectively, and C_a and C_b are amounts of the agricultural good and nonagricultural good, respectively, used as inputs in the production of X_1 and X_2, respectively. Labor in the output tier is assumed to be mobile between the two sectors in the short term, implying fewer labor market rigidities than in the input tier. That is, labor skills in output tier sectors are not sufficiently differentiated to justify a sector-specific specification.

Demand for labor is equal to available supply:

$$L^*(t) - L_a^*(t) - L_b^*(t) - L_o(t) = 0 \quad (9)$$

where $L^*(t)$ is the country's total labor supply and L_o is defined:

$$L_o(t) - L_1(t) - L_2(t) = 0 \quad (10)$$

$L_o(t)$ is thus total labor demand in the output tier.

A distinguishing characteristic between input and output tiers is the amount of factor mobility in the short term. In the input tier, production is a function of factors that are all fixed in the short term. Labor has a unique skill that is not immediately transferrable. However, over time, it is assumed that labor can migrate across sectors/tiers but that the migration is costly. Labor supply in the input tier equals the amount employed at t-1 less the amount that has migrated out of the sector (M_i). Labor in the output tier at time t is correspondingly equal to the amount employed at t-1 plus the net migration from the input tier:

$$L_a^*(t-1) - M_a(t-1) - L_a^*(t) = 0 \quad (11)$$

$$L_b^*(t-1) - M_b(t-1) - L_b^*(t) = 0 \quad (12)$$

$$L_o(t-1) + M_a(t-1) + M_b(t-1) - L_o(t) = 0 \quad (13)$$

Migration across sectors/tiers is unrestricted in sign. Later, the cost of migration will be seen to be related to differences in wage rates between sectors.

Capital follows a putty-clay specification. It is assumed that a portion of total nonfood production (X_2) can be diverted from present consumption (X_{c2}) and be allocated to capital augmentation (I). At time t, this portion (called investment) can be used to augment capital in either the agricultural or nonagricultural sector in the input tier. However, once capital has been formed, it cannot be adapted for use in the other sector. Changes in the distribution of capital occur only over time.

The augmentation of capital stocks is represented as follows:

$$V_a^*(t-1) + I_a(t-1) - V_a^*(t) = 0 \quad (14)$$

$$V_b^*(t-1) + I_b(t-1) - V_b^*(t) = 0 \quad (15)$$

where $I_i(t-1)$ is investment in sector i at time t-1. For simplicity, depreciation of capital stocks is ignored in this specification. As mentioned, investment comes from the production of the nonfood good:

$$X_2(t) - X_{c2}(t) - I(t) = 0 \tag{16}$$

$$I(t) - I_a(t) - I_b(t) = 0 \tag{17}$$

The nonfood final product (X_2) can be used for consumption (X_{c2}) or for investment (I). In simple one-sector growth models, it is often assumed that the consumption/investment tradeoff depends only on the average propensity to save, that is, a demand variable (3). Although this may be an appropriate assumption for the very long run, in the shorter term, there may be constraints in adjusting production from one use to the other. To capture this aspect, it is assumed that nonfood consumption and investment goods are produced as a joint product along lines suggested by Chang and others (5). Hence, at time t, a fraction of X_2 is produced for either consumption (b_2) or investment (b_I). The two fractions sum to one and the supply of X_2 is exhausted in the transformation process. These relationships are expressed as:

$$b_2(t)X_2(t) = X_{c2}(t) \tag{18}$$

$$b_I(t)X_2(t) = I(t) \tag{19}$$

$$b_2(t) + b_I(t) = 1 \tag{20}$$

The fractions b_2 and b_I are a function of the ratio of output prices p_{c2} and p_I:

$$b_I(t) = b_I(p_{c2}(t)/p_I(t)) \tag{21}$$

The sum of p_{c2} and p_I weighted by b_2 and b_I, respectively, is equal to the price of the nonfood composite:

$$b_2(t)p_{c2}(t) + b_I(t)p_I(t) = p_2(t) \tag{22}$$

The final goods are neither traded nor stored. They are consumed in the same time period in which they are produced:

$$X_1(t) - C_1(t) = 0 \tag{23}$$

$$X_{c2}(t) - C_2(t) = 0 \tag{24}$$

where C_1 and C_2 are the total demands for the final goods 1 and 2, respectively.

International Dimension

Middle products are traded in the world market. The amount is the difference between domestic supply and demand:

$$T_a(t) = X_a(t) - C_a(t) \tag{25}$$

$$T_b(t) = X_b(t) - C_b(t) \tag{26}$$

where T_i is the amount of good i traded. Although stockholding may be important to competitiveness issues in the short to medium term, its importance is suppressed here. See Sharples and Goodloe (24) for a discussion.

It is assumed that the country is a price taker in world commodity markets. The balance on the trade account (BT) is defined as follows:

$$BT(t) = p_a^*(t)T_a(t) + p_b^*(t)T_b(t) \tag{27}$$

where p_a^* and p_b^* are the world prices of the two tradeables.

It is not necessary that the trade account be in balance at time t. The trade account can be counterbalanced partially by the capital account. This balance (BFA) represents the total net value of borrowing in the international capital market. International borrowing entails an obligation to repay the principal accumulated in all prior time periods plus a premium derived from the world interest rate (i^*). This defines the debt service account (DSA):

$$DSA(t) = i^*(t)\sum_{k=-\infty}^{t-1} BFA(k) = i^*Z(t-1) \tag{28}$$

where $Z(t)=Z(t-1) + BFA(t)$ and

$$BT(t) - BFA(t) + DSA(t) = 0 \tag{29}$$

As distinguished from static models, a trade deficit permits a nation to expand its consumption possibility frontier outward by the amount of the net capital inflow. However, this process is self-limiting since service payments are due on debt accumulated from past capital inflows.

Transactions Demand for Money

There are two types of demand for money: transactions and speculative demand. In this section, only transactions demand is considered. Speculative demand is dealt with in the next section.

The utility yield of holding cash balances is associated with the reduction of expense in arranging transactions or exchanges among consumers and/or producers (18). Following Baumol (2),the individual's problem is one of inventory optimization. Income is received in the form of money, and money is required for purchases. Money has a fixed return of zero. However, there is a second class of assets, namely capital goods, which yield a nonzero rate of return and into which the consumer can invest. 4/ If the return on capital assets is certain, and if converting money into equity has a fixed cost and vice versa, the consumer may want to hold assets in the form of equity (that is, ownership of capital goods) as well as money. How much money on average the individual holds varies directly with income levels and asset conversion costs, and inversely with the supply of alternative assets:

$$M(t)/P(t) = L^d(V_a(t),V_b(t),y(t),fc_a(t),fc_b(t)) \tag{30}$$

4/ As will be seen later, there are other assets in addition to capital. However, at present, it is assumed that equity ownership is the only alternative form of investment available to the consumer.

where M is money supply, P is a price level index, y is real income, and fc_i are unit costs of converting from cash into equity i and vice versa.

Social Welfare and Optimum Conditions

In neoclassical tradition, the objective of policy is assumed to be the maximization of the discounted value of consumption over time:

$$W = \sum_{t=0}^{\infty} U(C_1(t), C_2(t), M(t)/P(t))(1-\mu)^t \tag{31}$$

where μ is the rate at which time is discounted. Food and nonfood products are consumed, and money is the medium of exchange, which lowers the cost of arranging exchanges. There are 19 conditions for an optimum. All variables have predetermined values at t=0. The lagrangian equation to be maximized is shown in table 1.

Differentiation of the lagrangian with respect to consumption levels at time t yields the following:

$$(\delta U/\delta C_1(t))(1-\mu)^t - p_1(t) = 0 \tag{32}$$

$$(\delta U/\delta C_2(t))(1-\mu)^t - p_2(t) = 0 \tag{33}$$

$$(\delta U/\delta (M(t)/P(t))(1-\mu)^t - \alpha(t) = 0 \tag{34}$$

Division of equation 32 by 33 yields the familiar result that the ratios of the marginal utilities of consumption should equal the ratio of product prices at an optimum. Equation 34 interprets $\alpha(t)$ as the marginal utility of money at time t.

Differentiation of the lagrangian with respect to input quantities yields the standard results regarding the equality of the marginal value product and the return to the input:

$$p_1(t)(\delta X_1/\delta L_1(t)) - w_o(t) = 0 \tag{35}$$

$$p_2(t)(\delta X_2/\delta L_2(t)) - w_o(t) = 0 \tag{36}$$

$$p_a(t)(\delta X_a/\delta L_a(t)) - w_a(t) = 0 \tag{37}$$

$$p_b(t)(\delta X_b/\delta L_b(t)) - w_b(t) = 0 \tag{38}$$

$$p_a(t)(\delta X_a/\delta V_a(t)) - r_a(t)(1-\alpha(t)) = 0 \tag{39}$$

$$p_b(t)(\delta X_b/\delta V_b(t)) - r_b(t)(1-\alpha(t)) = 0 \tag{40}$$

$$p_1(t)(\delta X_1/\delta C_a(t)) - p_a(t) = 0 \tag{41}$$

$$p_2(t)(\delta X_2/\delta C_b(t)) - p_b(t) = 0 \tag{42}$$

Equations 41 and 42 describe the demand for middle products by producers in the middle tier. Note that the wage rates in the two input tier sectors and the output tier are not necessarily the same. Recall that at time t, labor employed in the input tier sectors have no alternative uses outside the

Table 1--Lagrangian equation

$$L = \sum_{t=0}^{\infty} [U(C_1(t), C_2(t), M(t)/P(t)](1-\mu)^t$$

$$+p_1(t)(X_1(L_1(t), C_a(t)) - C_1(t))$$

$$+p_2(t)(X_2(L_2(t), C_b(t)) - X_{c2(}t) - I(t))$$

$$+p_{c2}(t)(X_{c2}(t) - C_2(t))$$

$$+p_I(t)(I(t) - I_a(t) - I_b(t))$$

$$+p_a(t)(X_a(L_a(t), V_a(t)) - T_a(t) - C_a(t))$$

$$+p_b(t)(X_b(L_b(t), V_b(t)) - T_b(t) - C_b(t))$$

$$+r_a(t)(V_a^*(t) - V_a(t))$$

$$+r_b(t)(V_b^*(t) - V_b(t))$$

$$+v_a(t)(V_a^*(t-1) + I_a(t-1) - V_a^*(t))$$

$$+v_b(t)(V_b^*(t-1) + I_b(t-1) - V_b^*(t))$$

$$+w(t)(L^*(t) - L_a^*(t) - L_b^*(t) - L_o(t))$$

$$+w_o(t)(L_o(t) - L_1(t) - L_2(t))$$

$$+w_a(t)(L_a^*(t) - L_a(t))$$

$$+w_b(t)(L_b^*(t) - L_b(t))$$

$$+m_a(t)(L_a^*(t-1) - M_a(t-1) - L_a^*(t))$$

$$+m_b(t)(L_b^*(t-1) - M_b(t-1) - L_b^*(t))$$

$$+m_o(t)(L_o(t-1) + M_a(t-1) + M_b(t-1) - L_o(t))$$

$$+e(t)(p_a^*(t)T_a(t) + p_b^*(t)T_b(t) - BFA(t) + i^*(t)(\sum_{j=-\infty}^{t-1} BFA(j))$$

$$+\alpha(t)((M(t)/P(t)) - L^d(V_a(t), V_b(t), \Phi(t))]$$

sectors in which they are employed. This sector specificity is reflected in the differing returns to capital employed in the input tiers as well (equations 39 and 40).

Over time, labor can migrate between tiers/sectors, and capital can be augmented by investment. These dynamic adjustments suggest that input price differentials should disappear over time. This can be seen in the solution conditions. The full set of first-order conditions implied by the labor employment conditions are as follows:

$$-w(t) + w_o(t) - m_o(t) + m_o(t+1) = 0 \quad (43)$$

$$-w(t) + w_a(t) - m_a(t) + m_a(t+1) = 0 \quad (44)$$

$$-w(t) + w_b(t) - m_b(t) + m_b(t+1) = 0 \quad (45)$$

where w is the shadow price of aggregate labor, w_i is the shadow price of labor in the i^{th} sector, and m_i is the shadow price of migration into/out of sector i.

Equations 43-45 say that, at an optimum, the deviation of the wage rate in sector i from the economywide (average) wage rate is equal to the difference in costs of labor reallocation between periods t and t+1. For instance, if the agricultural wage rate is below the economy average [that is, $w_a(t) < w(t)$], then the cost of migration out of the sector is less at the beginning of the next period than the current period. In the absence of externalities, one would predict an outflow of labor from agriculture.

Wage rates tend to equalize through time as labor migrates from low to high wage sectors. First-order conditions with respect to the migration variables are as follows:

$$-m_a(t+1) + m_o(t+1) = 0 \quad (46)$$

$$-m_b(t+1) + m_o(t+1) = 0 \quad (47)$$

Substitution of these conditions into equations 43-45 shows that wage differentials at time t are equal to initial differences in migration costs between sectors. Advancing these conditions one period ahead to obtain steady-state conditions shows that all wage rates will be equal at time t+1. Keep in mind, however, that there are no other externalities in this simple case.

Similar conditions hold for capital augmentation. First-order conditions derived from the full-employment of capital are as follows:

$$r_a(t) - v_a(t) + v_a(t+1) = 0 \quad (48)$$

$$r_b(t) - v_b(t) + v_b(t+1) = 0 \quad (49)$$

The difference in the price of sectoral capital stocks between periods (that is, $v_i(t) - v_i(t+1)$ for i=a,b) is equal to the marginal value product of each sector (r_i, i=a,b).

Given the putty-clay specification of capital, capital once formed cannot be adapted for use outside of the sector for which it was formed. This differs

from labor whose aggregate supply is fixed (or at least growing at a fixed rate). Adjustments there result from the reallocation of an existing pool of workers. For capital, investment adds to the stock of capital at the cost of deferred consumption. First-order conditions with respect to investment at time t are as follows:

$$v_a(t+1) - p_I(t) = 0 \tag{50}$$

$$v_b(t+1) - p_I(t) = 0 \tag{51}$$

where p_I is the price of the investment good. These conditions say that the shadow price of capital stocks next period are equal to the present value of investment, at an optimum. Substitution of these conditions into equations 48 and 49 implies that the difference of the marginal value products of the two capital stocks are inversely proportional to the prices of the respective capital stocks. Advancing these conditions one period shows that, at an optimum, the marginal product values are equal at time t+1.

Given its joint product specification, output from the nonfood sector can be used for consumption or for capital-stock augmentation (that is, investment). At an optimum, the price of output X_2 should be equal to the price of its use in consumption (p_{c2}) and its use in investment (p_I):

$$p_{c2}(t) - p_2(t) = 0 \tag{52}$$

$$p_I(t) - p_2(t) = 0 \tag{53}$$

Optimal conditions for trade in middle products are that the domestic price of each middle product should equal the international price of the product, adjusted by the shadow price of foreign exchange:

$$e(t)p_a^*(t) - p_a(t) = 0 \tag{54}$$

$$e(t)p_b^*(t) - p_b(t) = 0 \tag{55}$$

where e is the shadow price of foreign exchange.

The shadow price of foreign exchange, like the input shadow prices, links the present to the future:

$$-e(t) + \sum_{k=t+1}^{\infty} i^*(k)e(k) = 0 \tag{56}$$

This condition implies that the ratio of the value of foreign exchange at t+1 to the value at t is equal to the reciprocal of $[1 + i^*(t+1)]$. All else constant, a rise in the world interest rate decreases the value of foreign exchange.

Summary

Although not yet complete, the model has highlighted several areas that are important to agricultural comparative advantage and longer run agricultural competitiveness issues. Fixity of factors used in agricultural production shows that the aggregate agricultural supply curve may be very inelastic in the short run. This condition has been shown to be alleviated over time as

resources reallocate. The reallocation is manifest through the migration of labor across sectors/tiers and the changing of capital stocks through savings, investment, and international capital flows. The model recognizes adjustment costs, but implies that all adjustments take place in a clearly identifiable time frame. The time frame, however, may differ from country to country, rendering certain countries at a disadvantage if resources are slower to adjust. The competitive position of a country in an international market is intimately related to the level of its investment over time in that market.

The external debt is important to agricultural competitiveness. Unless offset by injections of international financial capital, high debt service payment requirements imply a corresponding surplus in the trade account. In the presence of factor market rigidities, this means a larger reduction in imports than expansion in exports. The direct effect is to limit agricultural imports. The indirect effect is to limit other imports that could be used to augment capital stocks. This limits economic growth prospects and probably restricts diversification out of relatively inefficient agricultural production systems. From the U.S. perspective, these import markets are likely to be willing to import only if credit is given to relax the foreign exchange constraint. Price competition among exporters may become supplanted by credit competition. Although this can persist up to the middle term, in time, costs are likely to become intolerable.

High world interest rates aggravate the high debt condition. Investment opportunities in developing countries appear less profitable, and hence, the likelihood of capital inflows to offset the debt service constraint is diminished. Variable interest rates on outstanding debt cause the payments to be higher. According to the model, the exchange rate depreciates in real terms. Because most of the debt is denominated in U.S. dollars, the level of debt in local currency is higher. Because real wealth is lower, consumption is reduced. This wealth effect reinforces the drop in import levels, although domestic savings available for investment should increase.

FINANCIAL SECTOR, WEALTH ACCOUNTS, AND CAPITAL FLOWS

Although certain longer term competitiveness and comparative advantage issues have been identified in the model, more can be done to make the modeling effort complete. Why international capital is attracted to a particular sector in a country is an important determinant of comparative advantage and competitiveness in the longer term. In the model developed thus far, capital flows serve mainly to augment domestic savings. It is implicitly assumed that its supply is infinitely elastic at the world interest rate. Although this approach may not be entirely inappropriate, more explicit treatment of capital flows is not difficult. Also, given the widespread belief that capital flows are principally a financial phenomenon, it is useful to set out the accounting so that the effect on the real economy is more clear.

Although the model incorporates a monetary sector, it is difficult to see how monetary disturbances could have any real effect on the economy. One need is to have an explicit bond sector in the model to give the notion of a domestic interest rate plausibility. Transactions demand involving equity shares as the alternative to cash holding seems forced. Also, speculative demand for

money, including possible currency substitution, may have implications for the flow of capital across borders. 5/

On the supply side, central bank behavior is likely to be important. Central bank behavior either directly or indirectly influences the value at which a currency trades in addition to domestic interest rates and price levels. Intervention in foreign exchange markets may have a different effect on the real economy than domestic credit creation. Drawing out the implications of monetary policies for asset values provides input for analyzing the effect on the agricultural sector.

The next section departs from the previous sections in that the capital account dynamics are examined via a reduced-form capital flow equation. This approach permits a more detailed examination of the interaction of the three types of assets considered. Later, the results will be appended to the investment planning approach. 6/

Capital Account

There are three types of assets that can cross borders: cash balances M, bonds B, and equity shares, which represent ownership of capital goods. Bonds represent all interest-bearing assets. It is assumed that they pay one unit of the debtor country's money per period. For simplicity, all bonds issued within a country are assumed to be perfect substitutes. The bonds earn an equal rate of return regardless of the issuer. The yield on domestic bonds is i^1 and on foreign bonds, i^2.

In the following, the first superscript refers to the issuing country, and the second, to the owner country. All prices, including the exchange rate, are assumed to be constant and equal to 1.

Home country wealth is defined as follows:

$$W^1 = V_a^{11} + V_b^{11} + V_a^{21} + V_b^{21} + B^{21}/i^2 - B^{12}/i^1 + M^{21} - M^{12} \qquad (57)$$

Similarly, foreign wealth is defined:

$$W^2 = V_a^{12} + V_b^{12} + V_a^{22} + V_b^{22} + B^{12}/i^1 - B^{21}/i^2 + M^{12} - M^{21} \qquad (58)$$

Because domestic holdings of domestically issued bonds represent both an asset and liability within the pertinent country, it does not appear in the wealth accounting.

The foreign component of wealth for the home country and the other country are as follows:

$$F^1 = V_a^{21} + V_b^{21} + B^{21}/i^2 + M^{21} = W^1 - V_a^{11} - V_b^{11} + B^{12}/i^1 + M^{12} \qquad (59)$$

$$F^2 = V_a^{12} + V_b^{12} + B^{12}/i^1 + M^{12} = W^2 - V_a^{22} - V_b^{22} + B^{21}/i^2 + M^{21} \qquad (60)$$

5/ See Haley (10) for a discussion of currency substitution and its potential effect on trade.

6/ This section follows Niehans (17), chapters 10 and 12.

The net international asset position of the home country equals F^1 less F^2 and is the difference between national wealth and the total real capital employed in the domestic economy:

$$A = W^1 - (V_a^{11} + V_a^{12}) - (V_b^{11} + V_b^{12}) \qquad (61)$$

At constant prices, the flow interpretation of the proceeding is that the increase in wealth is a nation's savings and the increase in real capital is investment. This perspective interprets a capital outflow in two equivalent ways: (1) as the excess of domestic savings over domestic investment, and (2) as the excess of foreign investment over foreign savings.

Because capital flows are portrayed as changes in net foreign assets, the analysis of capital flows can proceed as the accumulation or deaccumulation of individual assets. Each is represented as a stock demand function with income, yields, and the exchange rate serving as arguments:

$$X^d = X(y^1, y^2, v_a^1, v_b^1, v_a^2, v_b^2, i^1, i^2, e) \qquad (62)$$

The partial derivatives for each asset are shown in table 2.

The rise in domestic income has a positive effect on domestically owned assets while having no effect on foreign owned assets. The signs on the yields reflect that all assets are assumed to be gross substitutes. The increase in the return on a particular asset represents an increase in demand for that asset while indicating a decrease in demand for all other assets. The depreciation of the exchange rate (interpreted as foreign currency units per dollar) has a positive effect on dollar assets and a negative effect on foreign assets. This captures speculative effects where a depreciation (appreciation) generates the expectation of a future appreciation (depreciation). This raises the relative yield on dollar assets and lowers the foreign yield. The direct effect of a depreciation (appreciation) is to cause a capital inflow (outflow).

Higher interest rates do not necessarily attract capital inflows. The inflow would result only if higher interest rates were to increase domestic investment relative to savings. This condition is not likely to be met. The principal reason for direction of capital flows is the return on specific capital in a particular country.

Incorporating wealth effects of a change in the exchange rate brings on complications. If the debt is denominated in the creditor currency rather than the debtor currency, the positioning of gainers and losers is the opposite of what is implied in the table: the depreciating country loses, and the appreciating country gains. If all debt is denominated in the depreciating currency, the appreciating country gains if it is a debtor and loses if it is a creditor.

Financial/Government Sectors

In the preceding discussion, the relationships between assets were described in general terms. This section attempts to incorporate the results into the model described earlier.

For accounting simplicity, all additions to a sector's capital are assumed to be financed through the issuance of equity shares. This assumption obviates

Table 2--Partial derivatives of asset demand functions

	V_a^{11}	V_a^{12}	V_b^{11}	V_b^{12}	V_a^{21}	V_a^{22}	V_b^{21}	V_b^{22}	B^{11}	B^{12}	B^{21}	B^{22}	M^{11}	M^{12}	M^{21}	M^{22}
y^1	+	0	+	0	+	0	+	0	+	0	+	0	+	0	+	0
y^2	0	+	0	+	0	+	0	+	0	+	0	+	0	+	0	+
v_a^1	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
v_b^2	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-
v_a^2	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-
v_b^2	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-
i^1	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-
i^2	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-
e	-	-	-	-	+	+	+	+	-	-	+	+	-	-	+	+

the firm-level decision on how to finance new investment: there is no financing through private debt or retained earnings. It is not assumed that only households can be shareholders. Other firms or governments can be shareholders as well. Through government ownership of equities, publicly run enterprises can be incorporated into the model.

All debt in the economy represents government debt. At time t, all government spending (aggregated at the national level) is constrained to equal tax receipts (T(t)) and nonmonetized additions to the national debt:

$$G(t) = T(t) + (B(t) - B(t-1)) \tag{63}$$

The form of taxation is left unspecified, although trade taxes could be specified if relevant. What the government purchases is an open question because rent-seeking behavior is excluded from the model. However, it is important to recognize that government spending has investment components as well as consumption components. The investment spending could be more or less direct if the government is an important shareholder of an enterprise or if it channels subsidies to industry. On the other hand, it could be indirect if the investment is in the form of infrastructural development. Eisner (8) has argued that the lack of an appropriate accounting into consumption and investment components may seriously misrepresent the size and meaning of the U.S. Federal deficit. Considering that substantial government funds in the United States and other countries go for agricultural research, this type investment activity could be a major determinant of agricultural comparative advantage. This continues to be an important research area.

The Central Bank and Monetary Policy

It is generally well acknowledged that monetary policy can have short-term real effects on the economy. The central bank exercises policy primarily through the expansion or contraction of the monetary base. 7/ There are at least two alternative "pure" methods that the central bank can use to change money supply. The chosen method (or combination of the two) can be shown to have differential effects on the interest rate and the exchange rate. These effects in turn can affect other asset values and the real side of the economy.

The asset side of the central bank's balance sheet consists of domestic government bonds (b) and foreign assets (f). A useful simplification is that bonds and foreign assets are perpetuities with a coupon of one unit of the corresponding currency. Domestic money supply is expressed as follows:

$$(1/i^1)b + (1/i^2)(f/e) = M \tag{64}$$

Money supply can be increased through open market operations, that is, through the purchase of domestically issued bonds. The money supply can be alternatively increased through foreign asset purchases. Any combination of the two methods can be employed. If domestic and foreign bonds were perfect substitutes, the asset composition of the central bank would be immaterial. In this case, the difference between i^1 and i^2 would be the expected change in the exchange rate. This condition is commonly referred to as interest rate parity. Although this condition is often imposed, there is no

7/ In the following, there is no distinction between the money supply and the monetary base.

compelling reason to do so now. It should be an empirical matter whether interest parity holds.

The effect of monetary policy on the economy is initiated through its effect on asset prices. Because effects on other economic variables, such as investment, savings, production, consumption, and trade, are gradual, only impact effects are considered.

The private sector holds four assets: domestic money and bonds and foreign money and bonds. Conversion of these assets into equity is costly in the short term. The stock demand for each asset is a function of domestic and foreign interest rates and the exchange rate: 8/

$$M^1 = L^1(e,i^1,i^2) \quad L^1_1 < 0 \quad L^1_2 < 0 \quad L^1_3 < 0 \tag{65}$$

$$B/i^1 = B(e,i^1,i^2) \quad B_1 < 0 \quad B_2 > 0 \quad B_3 < 0 \tag{66}$$

$$F/i^2 = F(e,i^1,i^2) \quad F_1 > 0 \quad F_2 < 0 \quad F_3 > 0 \tag{67}$$

$$M^2 = L^2(e,i^1,i^2) \quad L^2_1 > 0 \; L^2_2 < 0 \; L^2_3 < 0 \tag{68}$$

In line with the short-term perspective, the effect of the exchange rate on asset demand is through speculative motives. An appreciation (depreciation) reduces the likelihood of a future increase (decrease) and increases the risk of a future depreciation (appreciation). The demand for foreign (domestic) assets rises as a result. Within a country, the tradeoff between domestic bonds and money is a function of the "own-country" interest rate. The effect of the "other-country" interest rate is conditioned on the assumption of gross substitutability.

Only three of the functions are independent. In subsequent analysis, consideration of foreign money demand is suppressed. Further, if the foreign interest rate is assumed to be constant, then the effect of central bank behavior on asset returns can be examined graphically. 9/

The relationships expressed in equations 65-68 are shown in figure 2. MM is the money equilibrium curve. Its negative slope says that with a depreciation and the resultant excess demand, the interest rate must rise to restore equilibrium. BB is the domestic bond equilibrium curve. Its negative slope says that a depreciation requires a fall in the interest rate to restore equilibrium. FF is the foreign asset equilibrium curve. Its slope is positive and more steeply inclined than BB: for an equivalent exchange rate change, the interest rate must adjust by a greater amount to restore equilibrium. Although this can be demonstrated mathematically, the idea is that domestic interest rate has a stronger impact on domestic bonds than on foreign bonds.

Expansion of the money supply through an open market operation is shown in figure 2. The MM curve shifts leftward to reflect the increase in money supply, and the BB curve shifts downward to reflect the purchase (or decrease) of domestic bonds. Because foreign assets are unaffected, FF remains

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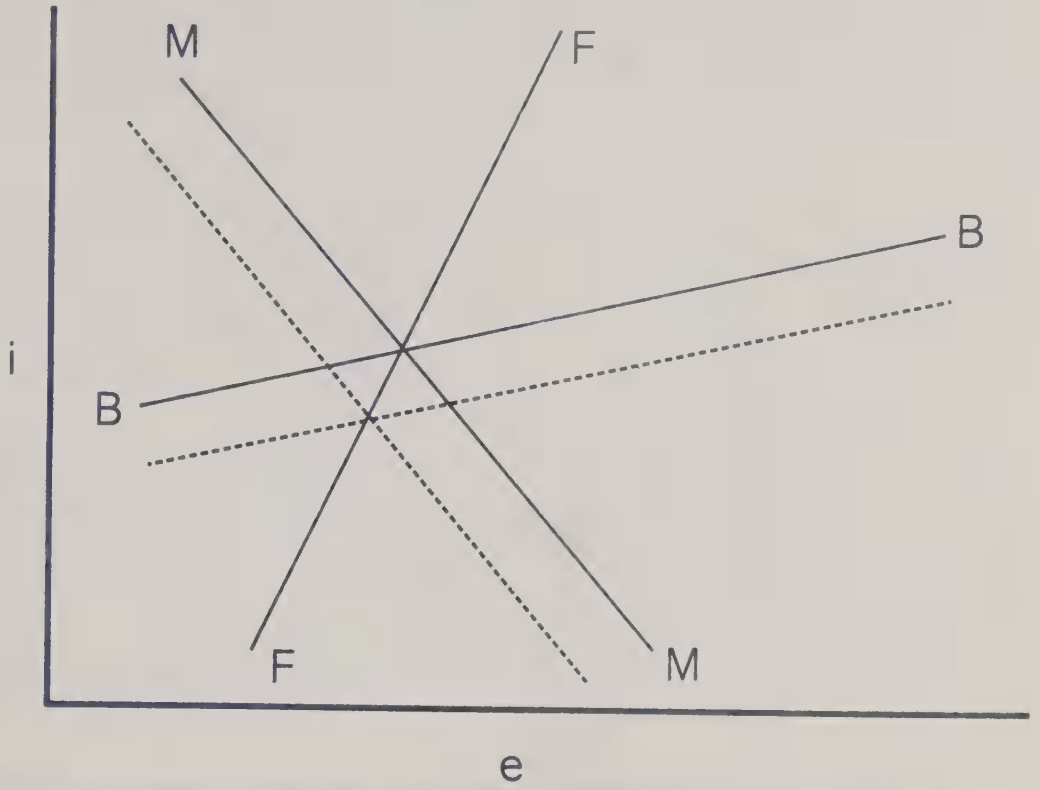
8/ Subscripts indicate the first derivative of the function with respect to the variable corresponding to the order within the parentheses.

9/ The full analysis is carried out in Niehans (17), chapter 12.

Figure 2

Open market operation



stationary. The effect on asset values is to decrease both the exchange rate and the interest rate.

Expansion of the money supply through the purchase of foreign assets is shown in figure 3. As before, the MM curve shifts leftward. If e=1 initially, then the FF curve shifts equiproportionally leftward. The BB curve remains stationary. The qualitative effect is the same as the open market operation: the interest rate and the exchange rate both decrease. However, the quantitative effects differ. The foreign asset purchase produces a larger exchange rate fall, while the open market operation produces a larger fall in the interest rate. This suggests that each policy alternative has its own "comparative advantage" in affecting asset values.

The case of "sterilization," where foreign assets are purchased and domestic bonds are sold so as to keep money supply constant, is shown in figure 4. BB and FF both shift leftward, and MM remains stationary. The interest rate rises and the exchange rate decreases. The opposite holds if foreign assets are sold and domestic bonds are purchased.

These theoretical results suggest that reliance on a simple direct relationship between interest rates and exchange rates may be misleading. The methods employed in changing money supply can affect the return on investment depending on the various asset substitution elasticities referred to in table 2. Eventually output and other prices are affected. Niehans has shown that if analysis is confined to a "Keynesian" sticky price economy where foreign debt holdings are initially zero, then intervention in foreign asset markets have strong effects on real output through the balance-of-payment accounts. The effects of open market operations are weaker for output expansion but they have stronger effects on domestic interest rates. Niehans' results are merely

Figure 3

Foreign asset purchase

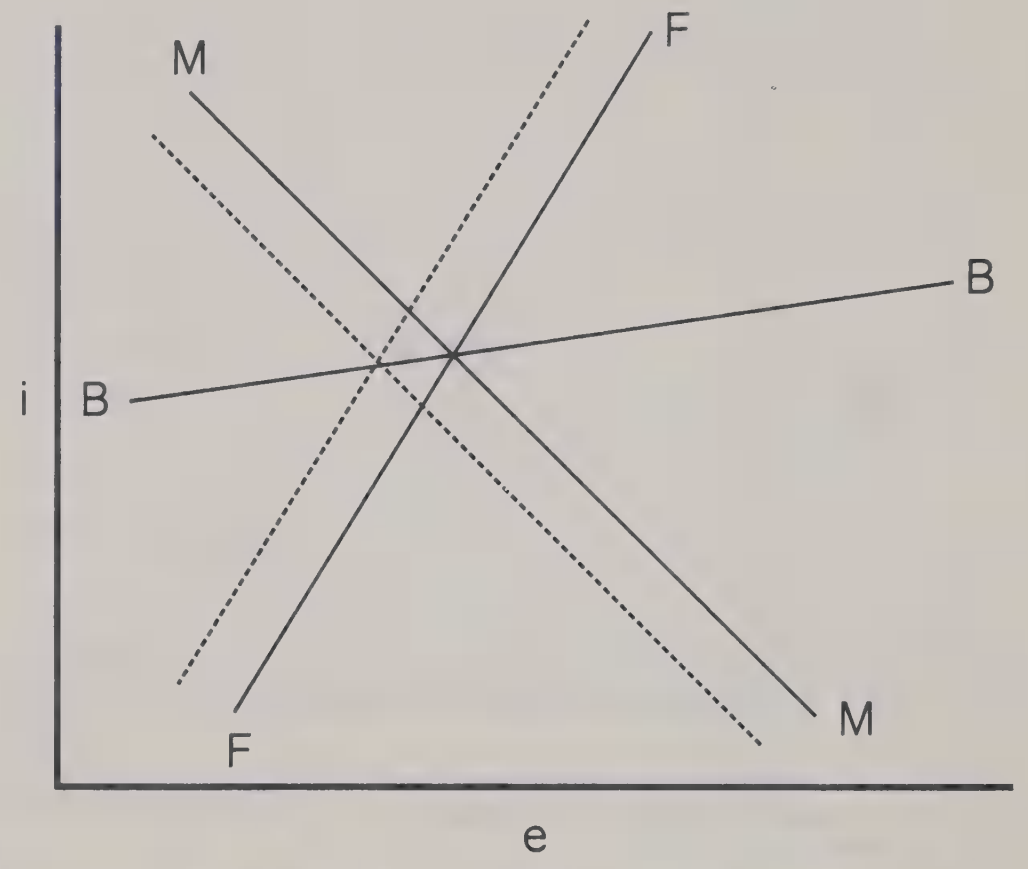
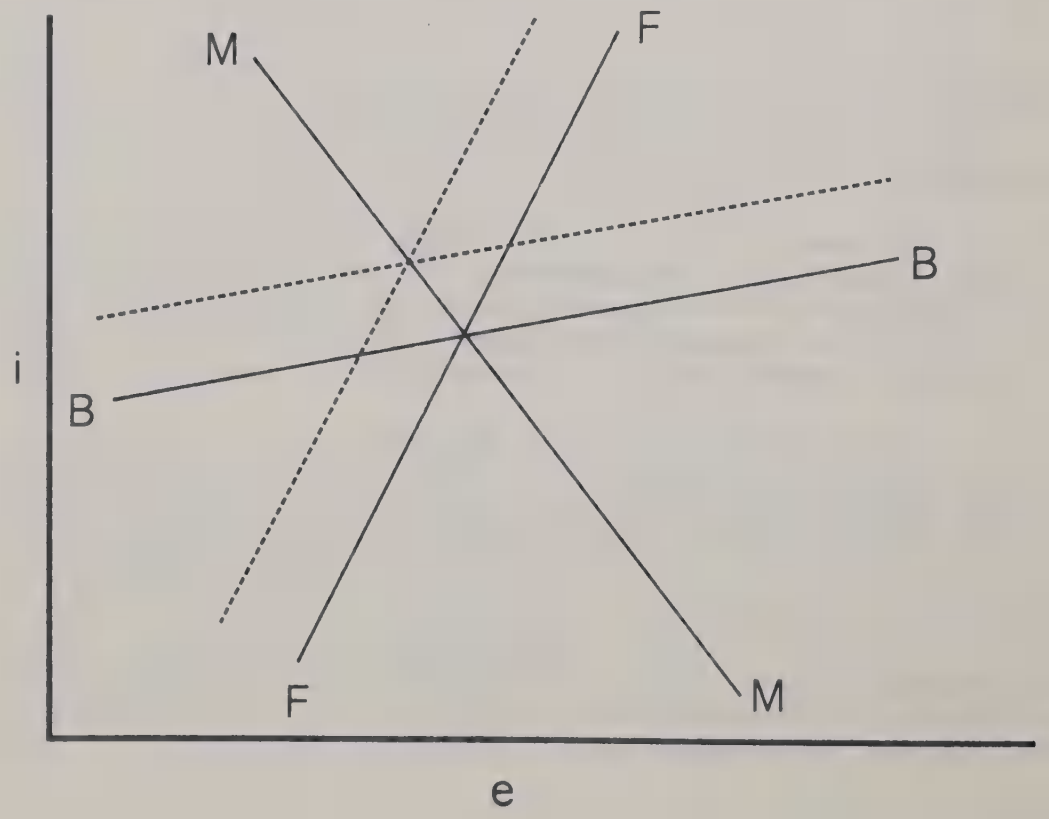


Figure 4

Domestic bond sale and foreign asset purchase



suggestive of the desirability of additional research based on estimates of the dynamic model specified in this paper. If central bank intervention in foreign asset markets does indeed have a stronger effect on the exchange rate, then the effect on a sector like agriculture, which is highly dependent on trade, may be strong as well. The longer term effects in addition to the impact effects must be taken into account.

CONCLUSIONS

The purpose of economic theory is to provide insight through analysis into pressing economic problems. This paper has been directed toward a host of problems regarding agricultural competitiveness in the 1980's. Although these issues have been diverse, concern about them has resulted due to the trend of declining U.S. agricultural export sales and loss of market share.

The paper has focused on setting up the context for highlighting some of the causes of the decline and for evaluating the longer term consequences based on changing agricultural comparative advantage. The debt crisis and the appreciation of the dollar have figured prominently in the decline. Underlying these phenomena have been tremendous increases in the flow of capital across borders and wide variance in monetary policies over the past 20 years. For international agriculture as well as other sectors, these events have generated large resource adjustments on the supply side. On the demand side, changes have resulted from erratic real income growth and foreign exchange constraints.

Discussion of the appropriate modeling approach has centered on a dynamic Ricardo-Viner type of trade model in which capital flows and monetary policies play important roles. Specificity of factors constitute short- to medium-term rigidities that make adjustment to a deteriorating economic environment particularly difficult in terms of factor income. Nontraded goods other than factors of production are differentiated on the basis of intermediate good content. Gains to trade are still connected to the expansion of the availability of goods to the consumer at a lower relative price, but this expansion is due to the enrichment of the availability of inputs rather than to trade in final commodities.

The largest omission from the model is rent-seeking behavior by special interest groups. Because the level of protection accorded agriculture is large for many countries, this issue will have to be explicitly modeled at some point. Honma and Hayami (13) have recently found that the greater the cost of intersectoral labor adjustments corresponding to a shift in comparative advantage away from agriculture, the greater the demand for agricultural protectionism. Likewise, a smaller agricultural sector makes it easier for farmers to be effective in political lobbying. The conceptual model identifies the rigidities that make successful lobbying on behalf of agriculture likely according to the Honma-Hayami criteria. More work will have to be done to incorporate the general equilibrium effects of lobbying into the model.

One of the goals of this modeling exercise has been to suggest avenues of research for those in ERS interested in international macroeconomics and agricultural trade. The conceptual framework identifies only several of the important links. Specific comparative static results await specific empirical specification of models. This observation argues that theoretical approaches

are unlikely to be sufficient to answer many of the questions important to comparative advantage and longer term competitiveness issues.

Many applied modeling approaches are available. These approaches include the class of Computable General Equilibrium (CGE) models seen in Dervis and others (6) and Shoven and Whalley (25). Within ERS, the class of SWOPSIM models provide a relatively cost-efficient means of model creation (20). Krissoff and Ballenger (15) have used the SWOPSIM framework to model macroeconomic adjustment to trade liberalization in major Western Hemisphere countries. This type of effort points the way for continued international macroeconomic modeling within the agency. The conceptual view examined in this paper will be justified to the extent that some of its ideas can be incorporated in these applied models.

REFERENCES

1. Abbott, P.C., and R.L. Thompson, "Changing Agricultural Comparative Advantage," Agricultural Economics. Forthcoming 1987.

2. Baumol, W.J. "The Transactions Demand for Cash: An Inventory Theoretic Approach," Quarterly Journal of Economics, 1952.

3. Burmeister, E. Capital Dynamics. New York: Cambridge University Press, 1981.

4. Cavallo, D., and Y. Mundlak. Agriculture and Economic Growth in an Open Economy: The Case of Argentina. International Food Policy Research Institute, Dec. 1982.

5. Chang, W.W., W.J. Ethier, and M.C. Kemp. "The Theorems of International Trade with Joint Production," Journal of International Economics. Vol. 10 (1980), 377-94.

6. Dervis, K., J. De Melo, and S. Robinson. General Equilibrium Models for Development Policy. New York: Cambridge University Press, 1982.

7. Dixit, A.K., and V. Norman. Theory of International Trade. Welwyn, Great Britain: Cambridge University Press, 1980.

8. Eisner, R. How Real Is the Federal Deficit? New York: Free Press, 1986.

9. Findlay, R. "Factor Proportions and Comparative Advantage in the Long Run," Journal of Political Economy. Vol. 78 (1970), 27-34.

10. Haley, S.L. Currency Substitution: A Test of Its Importance for the United States and Implications for Agricultural Trade, ERS Staff Report No. AGES860328. U.S. Dept. Agr., Econ. Res. Serv., Apr. 1986.

11. Haley, S.L., and P.C. Abbott. An Investigation of the Determinants of Agricultural Comparative Advantage. Purdue Research Bulletin 984. Purdue Agricultural Experiment Station, West Lafayette, IN, Sept. 1986.

12. Haley, S.L., and B. Krissoff. "U.S. Grain Exports and the Value of the Dollar," unpublished report, U.S. Dept. Agr., Econ. Res. Serv., Dec. 1986.

13. Honma, M., and Y. Hayami. "Structure of Agricultural Protection In Industrial Countries," Journal of International Economics Vol. 20 (1986), 115-29.

14. Houthakker, H.S. "An International Comparison of Household Expenditure Patterns, Commemorating the Centenary of Engel's Law," Econometrica Vol. 25 (1957), 532-51.

15. Krissoff, B., and N. Ballenger, "The Effect of Trade and Exchange Rate Liberalization on Agricultural Trade: Case Studies of Argentina, Brazil, and Mexico," unpublished report, U.S. Dept. Agr., Econ. Res. Serv., Feb. 1987.

16. Neary, J.P. "Dynamic Stability and the Theory of Factor Market Distortions," American Economic Review Vol. 68 (1978), 671-82.

17. Niehans, J. International Monetary Economics. Baltimore: The Johns Hopkins University Press, 1984.

18. Patinkin, D. Money, Interest, and Prices. New York: Harper and Row, 1965.

19. Rausser, G.C., J.A. Chalfant, H.A. Love, and K. Stamoulis. "Macro-economic Linkages, Taxes, and Subsidies in the U.S. Agricultural Sector," California Agricultural Experiment Station, Giannini Foundation of Agriculture, Berkeley, 1986.

20. Roningen, V.O. A Static World Policy Simulation (SWOPSIM) Modeling Framework, ERS Staff Report No. AGES860625. U.S. Dept. Agr., Econ. Res. Serv., July 1986.

21. Sanyal, K.K., and R.W. Jones. "The Theory of Trade in Middle Products," American Economic Review Vol. 72 (1982), 16-31.

22. Schuh, G.E. "The Exchange Rate and U.S. Agriculture," American Journal of Agricultural Economics Vol. 56 (1974), 1-13.

23. Shane, M.D., and D. Stallings. Financial Constraints to Trade and Growth: The World Debt Crisis And Its Aftermath. FAER-211. U.S. Dept. Agr., Econ. Res. Serv., Dec. 1984.

24. Sharples, J.A., and C.A. Goodloe. Global Stocks of Grain: Implications for U.S. Policy. ERS Staff Report No. AGES840319. U.S. Dept. Agr., Econ. Res. Serv. May 1984.

25. Shoven, J.B., and J. Whalley. "Applied General Equilibrium Models of Taxation and International Trade: An Introduction and Survey," Journal of Economic Literature Vol. 12 (1984), 1007-51.

26. Smith, A. "Capital Theory and Trade Theory," Handbook of International Economics, eds. R.W. Jones and P.B. Kenen. Amsterdam: North Holland, 1984.

27. U.S. Department of Agriculture, Economic Research Service. Agricultural Outlook. Various issues.

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